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P102599GB

## 2. Patent application number

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26 SEP 2003

0322591.9

## 3. Full name, address and postcode of the or of each applicant (underline all surnames)

Hawke Cable Glands Limited  
Oxford Street West  
Ashton-Under-Lyne  
Lancashire  
OL7 0NA

00491712001

Patents ADP number (if you know it)

If the applicant is a corporate body, give the country/state of its incorporation

United Kingdom

## 4. Title of the invention

An electronic circuit

## 5. Name of your agent (if you have one)

Harrison Goddard Foote

"Address for service" in the United Kingdom to which all correspondence should be sent (including the postcode)

Orlando House,  
11c Compstall Road  
Marple Bridge  
Stockport  
SK6 5HH

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Country

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## 7. If this application is divided or otherwise derived from an earlier UK application, give the number and the filing date of the earlier application

Number of earlier application

Date of filing  
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- a) any applicant named in part 3 is not an inventor, or
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Claim(s) 3 ✓

Abstract 1 ✓

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Request for preliminary examination and search (Patents Form 9/77) 1 ✓

Request for substantive examination (Patents Form 10/77) -

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Letter ✓

11.

We request the grant of a patent on the basis of this application.

*Harrison Goddard Foote*

Signature

Date

HARRISON GODDARD FOOTE

26/09/03

12. Name and daytime telephone number of person to contact in the United Kingdom

Sean Thomas, 0161 427 7005

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**Patents Form 1/77**

### An electronic circuit

The present invention relates to electronic circuits and particularly electronic circuits  
5 suitable for terminating a transmission path or channel, such as a communication  
network, for example, a transmission bus network or daisy chain system.

For the benefit of clarity the present invention will be described in relation to bus  
networks. However, the reader will appreciate that the present invention is equally  
10 applicable to other network systems such as, for example, daisy chain systems.

A bus network is a plurality of conductors, which serve as a common connection for a  
group of devices. Although transmission bus networks may comprise any number of  
conductors, for simplicity the present invention will be described in relation to a two-  
15 conductor bus network. However, the reader will appreciate that the invention is equally  
applicable to networks having more than two conductors.

In order to substantially mitigate, or limit, errors in signals being transmitted,  
maintenance of the integrity of the transmitted signal and minimising propagation delays  
20 and power consumption are important considerations in the engineering of transmission  
bus networks.

These considerations are substantially addressed by terminating the network with a terminating circuit having appropriate matching impedance. It is normal practice to terminate the network at both ends, that is, at the host and at the end node of the active network. This is generally carried out by manual selection and installation of the

5 termination circuit, which typically comprises a terminating resistor in series with a terminating capacitor. A typical network will have multi-drop connections at nodes, which are interfaced to local devices.

A disadvantage of known networks of this type is that, upon occurrence of a fault in the

10 network system such as, for example, an open circuit, the signal integrity is lost. Furthermore, such faults are usually difficult to locate within a network and, in such a state, the network is difficult to maintain in a stable condition. This results in considerable amounts of time being spent locating and fixing the fault and maintaining communication between the host and the nodes in the network until the fault is fixed,

15 which is undesirable.

Also, the signal integrity is dependent on the engineer ensuring terminating circuits are specified and fitted correctly and that none of the nodes upstream of the end node are fitted with terminating circuits. Furthermore, if a change or modification is carried out to

20 the network it is necessary for the engineer to check the impedance characteristics of the whole network system. Again, this is undesirably time consuming and expensive.

An object of the present invention is to provide an electronic circuit capable of maintaining the integrity of transmitted signals by terminating the network at a node thereof.

- 5 A further object of the present invention is to provide a node comprising such an electronic circuit.

A further object of the present invention is to provide a network comprising a plurality of such circuits.

10

The present invention provides an electronic circuit, capable of terminating a plurality of conductors at, or near, a node on a network, comprising detecting means, operable to detect current in at least one of the plurality of conductors, and switching means operable to switch the circuit between being a continuing circuit, upon the detecting means

- 15 detecting a current greater than a first predetermined threshold, and being a terminating circuit, upon the detecting means detecting current at, or less than, a second predetermined threshold.

The terminating circuit advantageously comprises impedance matching means. The  
20 impedance matching means may comprise a terminating resistor connected in series with a terminating capacitor.

The terminating circuit is preferably connected between the at least one of the plurality of conductors and the, or each, of the other conductors.

The network may be an active network and the node may be the end node of that active  
5 network.

The first threshold may be greater than the second threshold.

The detecting means preferably comprises a sensing resistor, connected in series with the  
10 at least one of the plurality of conductors, and means for detecting voltage across the sensing resistor. The means for detecting voltage is preferably a differential amplifier.

The switching means preferably comprises a transistor wherein the base terminal thereof is connected to an output of the detecting means. The collector terminal of the transistor  
15 is preferably connected to the impedance matching means and the emitter terminal is preferably connected to the, or each, of the other conductors.

The present invention also provides for a network node comprising an electronic circuit as herein defined in the preceding six paragraphs.

20

The present invention also provides a network comprising at least one electronic circuit as herein defined in the preceding six paragraphs.

The present invention will now be described by way of example, with reference to the following drawings, in which:

Figure 1 is a schematic diagram of an electronic circuit according to the present invention; and,

Figure 2 is schematic drawing of a network comprising the electronic circuit of Figure 1

Referring to Figures 1 and 2, an electronic circuit 10, suitable for terminating a two-conductor 12a and b network system 14 at, or near, a node 16 disposed thereon, comprises detecting means 18, switching means 20 and a terminating circuit 21. The two-conductor network system may be, for example, a two-wire transmission bus system.

The detecting means comprises a sensing resistor 22, connected in series with the first conductor 12a, and means to detect voltage across the sensing resistor 22 in the form of a differential amplifier 24. The differential amplifier 24 has first and second inputs, 26 and 28, and an output 30. The first and second inputs, 26 and 28, are connected to the first conductor 12a, across the sensing resistor 22.

20

The switching means 20 comprises a transistor 32 having a base terminal 34, collector terminal 36 and emitter terminal 38. Figure 1 shows a NPN bipolar resistor. However, it will be appreciated that other types of bipolar transistor, such as PNP, or field effect



transistor, such as a MOSFET, are equally applicable to working the invention. The switching means further comprises a limiting resistor 40.

The terminating circuit 21 comprises a terminating capacitor 42 connected in series with  
5 a terminating resistor 44, one end of the terminating circuit being connected to the first conductor 12a and the other end being connected to the second conductor 12b by way of the switching means 20.

The first and second inputs, 26 and 28, of the differential amplifier 24 are connected to  
10 the sensing resistor 22, such that the first input is connected upstream and the second input downstream of the sensing resistor. The direction of flow of current in the first conductor is from left to right in the drawings.

The limiting resistor 40 of the switching means 20 is connected, in series, intermediate  
15 the output 30 of the differential amplifier 24 and the base terminal 34 of the transistor 32. The collector terminal 36, of the transistor, is connected to the terminating circuit 21. The terminating circuit is also connected to the first conductor 12a upstream of the sensing resistor 22.

20 The emitter terminal 38, of the transistor, is connected to the second conductor 12b.

The current flowing in the first conductor 12a is detected by sensing the voltage drop across the sensing resistor 22. The voltage drop is maintained at a minimum value by

selecting a relatively low value for the sensing resistor. The voltage drop across the sensing resistor 22 is measured by the differential amplifier 24.

Upon detecting current flowing through the sensing resistor 22 greater than a first  
5 predetermined threshold the input differential of the differential amplifier is significant  
and the output 30 is driven low relative to the voltage at the collector terminal 36.  
Therefore, the switching means 20 will remain open and the circuit 10 will be maintained  
as a continuing circuit. However, upon detecting no current flowing at, or less than, a  
second predetermined threshold the differential will be high and the output 30 will be  
10 high relative to the voltage at the collector terminal 36. Therefore, switching means will  
switch to connect the terminating circuit 21 second conductors 12 b and the network will  
be terminated such that the integrity of signals being transmitted on the network are  
maintained.

15 The first and second threshold may be the same to define a switching threshold, such as,  
for example, 0 Volts. Alternatively, the first and second thresholds may be different such  
that, for example, the switching means maintains a continuing circuit if a voltage greater  
than 3 Volts is detected and switches to the terminating circuit if a voltage of 3 Volts, or  
less, is detected. However, it will be appreciated that thresholds defining different  
20 voltages are equally applicable to the invention.

Referring to Figure 2, the network 14 comprises a plurality of nodes  $16^1$  to  $16^N$  connected, from a host 17, by the first and second conductors 12a and b. Each node 16 comprises a respective electronic circuit  $10^1$  to  $10^N$  disposed therein.

- 5 Upon a fault occurring, such as for example an open circuit at node  $16^{N+1}$ , the current flowing through the first conductor 12a to that node will stop, or at least reduce. Such a fault causes a mis-match of the impedance of the network as a whole and therefore the integrity of the signals transmitted will not be maintained even in respect of nodes in which there is no fault. On detection of the changes of current flowing from node  $16^N$  to
- 10  $16^{N+1}$  the electronic circuit  $10^N$ , disposed in node  $16^N$ , switches it from being a continuing circuit to being a terminating circuit whereby the impedance of the network is matched by appropriate termination thereby maintaining the integrity of the signals transmitted.

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**CLAIMS:**

1. An electronic circuit, capable of terminating a plurality of conductors at, or near, a  
5 node on a network, comprising detecting means, operable to detect current in at least  
one of the plurality of conductors, and switching means operable to switch the circuit  
between being a continuing circuit, upon the detecting means detecting current  
greater than a first predetermined threshold, and being a terminating circuit, upon the  
detecting means detecting current at, or less than, a second predetermined threshold.  
10
2. An electronic circuit as claimed in Claim 1, wherein the terminating circuit comprises  
impedance matching means.
3. An electronic circuit as claimed in Claim 2, wherein the impedance matching means  
15 comprises a terminating resistor connected in series with a terminating capacitor.
4. An electronic circuit as claimed in any of the preceding claims, wherein the network  
is an active network and the node is an end node of the active network.
- 20 5. An electronic circuit as claimed in any of the preceding claims wherein the first  
threshold is greater than the second threshold.

6. An electronic circuit as claimed in any of the preceding claims, wherein the detecting means comprises a sensing resistor, connected in series with the at least one of the plurality of conductors, and means for detecting voltage across the sensing resistor.
- 5 7. An electronic circuit as claimed in Claim 6, wherein the means for detecting voltage is a differential amplifier.
8. An electronic circuit as claimed in any of the preceding claims wherein the switching means comprises a bipolar or field effect transistor.
- 10 9. An electronic circuit as claimed in Claim 8, wherein the transistor is connected to an output of the detecting means.
10. An electronic circuit as claimed in Claims 8 or 9, wherein the transistor is a NPN bipolar transistor comprising a collector terminal, connected to the impedance  
15 matching means, and an emitter terminal connected to the, or each, of the other conductors.
11. A node comprising an electronic circuit as claimed in any of the preceding claims.
- 20 12. A network comprising at least one electronic circuit as claimed in any of the preceding claims.
13. An electronic circuit as substantially herein described with reference to as shown in  
25 the accompanying drawings.

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14. A node as substantially herein described with reference to as shown in the accompanying drawings.

5 15. A network as substantially herein described with reference to as shown in the accompanying drawings.

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**ABSTRACT:**

An electronic circuit for terminating a plurality of conductors at a node of an active network, comprising means to detect current flowing through one of the conductors and  
5 means to switch between a continuing circuit, whereby continuity of the network is maintained, on detecting current above a first predetermined threshold, and a terminating circuit, whereby the network is terminated with an appropriate terminating circuit, upon detection of current at, or below, a second predetermined threshold.

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1 / 1

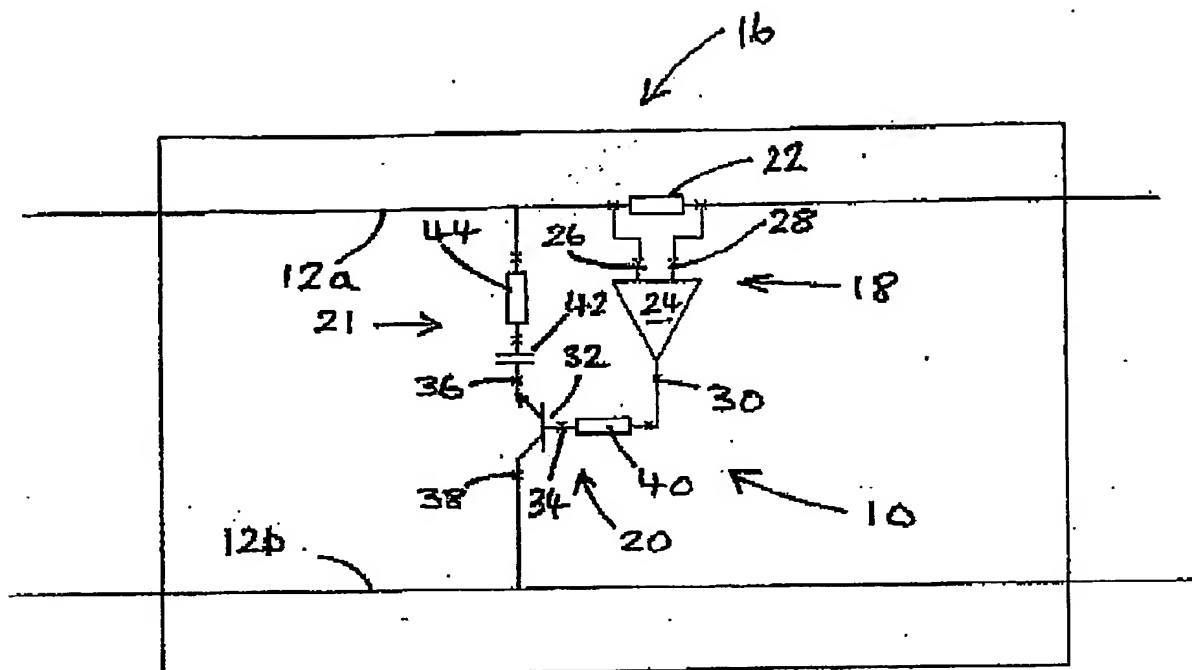


FIGURE 1

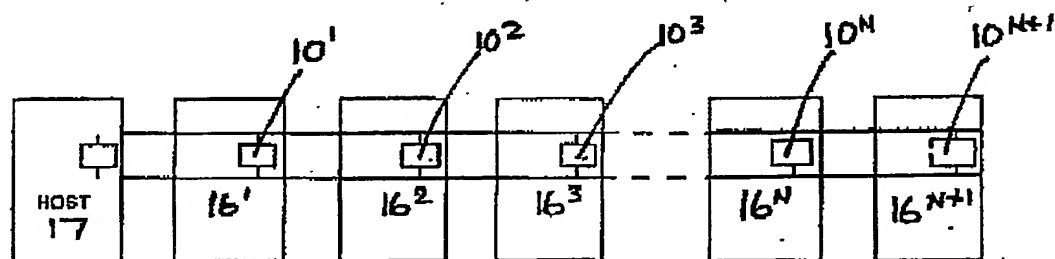
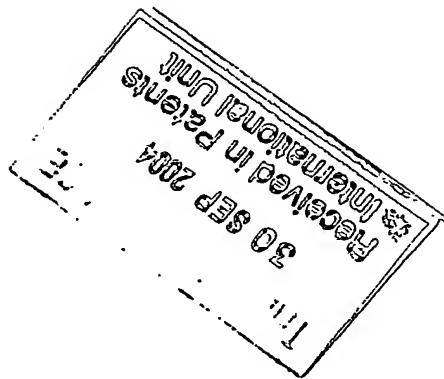


FIGURE 2





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